

Remarks

Reconsideration and allowance of the subject application are respectfully solicited.

Claims 1-5 and 7-11 remain pending in the application, with Claims 1 and 11 being independent and having been amended herein.

Claim 11 was rejected under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 5,923,344 (Norum et al.). Claims 1, 2, 4, 5 and 8-10 were rejected under 35 U.S.C. § 103 as being unpatentable over Norum et al. in view of U.S. Patent No. 6,227,644 (Perner). Claims 1-4 and 7-10 were rejected under § 103 as being unpatentable over Norum et al. in view of U.S. Patent No. 5,448,269 (Beauchamp et al.). These rejections are respectfully traversed.

As is recited in independent Claim 1, the present invention relates to a printing apparatus for printing an image on a printing medium while relatively moving at least one of a printing head provided with an array of a plurality of printing elements and the printing medium. The apparatus includes a carriage, detection means, determining means and control means. The carriage mounts the printing head, and is movable relative to the printing medium in a scanning direction crossing the array of the plurality of printing elements. The detection means is mounted on the carriage and detects printing positions of an array of printed pixels corresponding to the array of the plurality of printing elements. The detecting means detects printed pixels printed by any of the plurality of printing elements. The determining means determines all of the printing elements from among the plurality of printing elements that have displacement amounts of printing positions of

corresponding printed pixels from a printing position of a printed pixel corresponding to one end side of the array of printing elements equal to or greater than a predetermined amount. The control means adjusts drive timing of the plurality of printing elements according to detection results of the detection means so as to make printing positions of subsequently printed pixels close to a predetermined center position. The control means adjusts the drive timing of all of the printing elements determined by the determining means, so that a deviation amount between printing positions of printed pixels corresponding to the one end side and the other end side of the array of printing elements is equal to or smaller than the predetermined amount. The control means does not adjust the drive timing of a plurality of printing elements that are positioned continuously from a printing element positioned at the one end side of the array of printing elements and that have displacement amounts of printing positions of corresponding printed pixels from the printing position of the printed pixel corresponding to the one end side of the array of printing elements less than the predetermined amount. The control means does adjust the drive timing of any of printing elements that are positioned continuously from a printing element positioned at the other end side of the array of printing elements and that have displacement amounts of printing positions of corresponding printed pixels from the printing position of the printed pixel corresponding to the one end side of the array of printing elements equal to or greater than the predetermined amount. All of the printing elements determined by the determining means exclude the one end side of the array of printing elements.

As is recited in independent Claim 11, the present invention relates to a printing method for printing an image on a printing medium while relatively moving at least one of a printing head provided with an array of a plurality of printing elements and the printing medium. The method comprises the steps of relatively moving at least one of the printing head and the printing medium in a scanning direction crossing the array of the printing elements so that an array of printed pixels corresponding to the array of the printing elements is printed on the printing medium, detecting printing positions of the array of printed pixels by detecting printed pixels printed by any of the plurality of printing elements, determining all of the printing elements from among the plurality of printing elements that have displacement amounts of printing positions of corresponding printed pixels from a printing position of a printed pixel corresponding to one end side of the array of printing elements equal to or greater than a predetermined amount, and adjusting drive timing of the plurality of printing elements according to detection results of the printing positions so as to make printing positions of subsequently printed pixels close to a predetermined center position. The adjusting step adjusts drive timing of all of the printing elements determined in the determining step, so that a deviation amount between printing positions of printed pixels corresponding to the one end side and the other end side of the array of printing elements is equal to or smaller than the predetermined amount. The drive timing of a plurality of printing elements that are positioned continuously from a printing element positioned at the one end side of the array of printing elements and that have displacement amounts of printing positions of corresponding printed pixels from the printing position of the printed pixel corresponding to the one end side of the array of

printing elements less than the predetermined amount are not adjusted. The drive timing of any of printing elements that are positioned continuously from a printing element positioned at the other end side of the array of printing elements and that have displacement amounts of printing positions of corresponding printed pixels from the printing position of the printed pixel corresponding to the one end side of the array of printing elements equal to or greater than the predetermined amount is adjusted. All of the printing elements determined in the determining step exclude the one end side of the array of printing elements.

With the above arrangement and method, drive timing of the printing elements can be adjusted on the basis of one end side of the array of printing elements, so that printing positions of pixels are close to a predetermined center position. The drive timing of printing elements that are positioned continuously from the one end side and are within the predetermined amount is not adjusted. On the other hand, the drive timing of any printing elements that are continuously positioned from the other end and are outside the predetermined amount is adjusted. This adjustment can be particularly suitable in a printing apparatus in which the array of printing elements is inclined due to an error in mounting the printing head.

In Norum et al., pixel alignment of drops can be performed along the lines shown in Figs. 3 and 4. In order to form a vertical line in a horizontal pixel region defined between scale lines 66 and 67, the timing for nozzles corresponding to dots outside the horizontal pixel region is adjusted. A sub-pixel alignment of drops can also be performed as shown in Fig. 4. Although pixel 78 in Figs. 3 and 4 of Norum et al. may not be moved,

there is no disclosure or suggestion in Norum et al. that the position of an end pixel can be used as a baseline for determining displacement amounts of other pixels. Furthermore, there is no disclosure or suggestion in Norum et al. of not adjusting the drive timing of printing elements that are positioned continuously from a printing element positioned at one end side and that have displacement amounts less than the predetermined amount, while adjusting the drive timing of any printing elements that are positioned continuously from a printing element positioned at the other end side and that have displacement amounts greater than the predetermined amount, as is recited in independent Claims 1 and 11.

Thus, Norum et al. fails to disclose or suggest important features of the present invention recited in independent Claims 1 and 11.

Perner and Beauchamp et al. have also been reviewed, but are not believed to remedy the deficiencies of Norum et al. noted above with respect to independent Claims 1 and 11.

Thus, independent Claims 1 and 11 are patentable over the citations of record. Reconsideration and withdrawal of the §§ 102 and 103 rejections are respectfully requested.

For the foregoing reasons, Applicants respectfully submit that the present invention is patentably defined by independent Claims 1 and 11. Dependent Claims 2-5 and 7-10 are also allowable, in their own right, for defining features of the present invention in addition to those recited in their respective independent claims. Individual consideration of the dependent claims is requested.

This Amendment After Final Rejection is an earnest attempt to advance prosecution and reduce the number of issues, and is believed to clearly place this application in condition for allowance. This Amendment was not earlier presented because Applicants earnestly believed that the prior Amendment placed the subject application in condition for allowance. Accordingly, entry of this Amendment under 37 CFR 1.116 is respectfully requested.

Applicants submit that the present application is in condition for allowance. Favorable reconsideration, withdrawal of the rejections set forth in the above-noted Office Action, and an early Notice of Allowability are requested.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Mark A. Williamson", written over a horizontal line.

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